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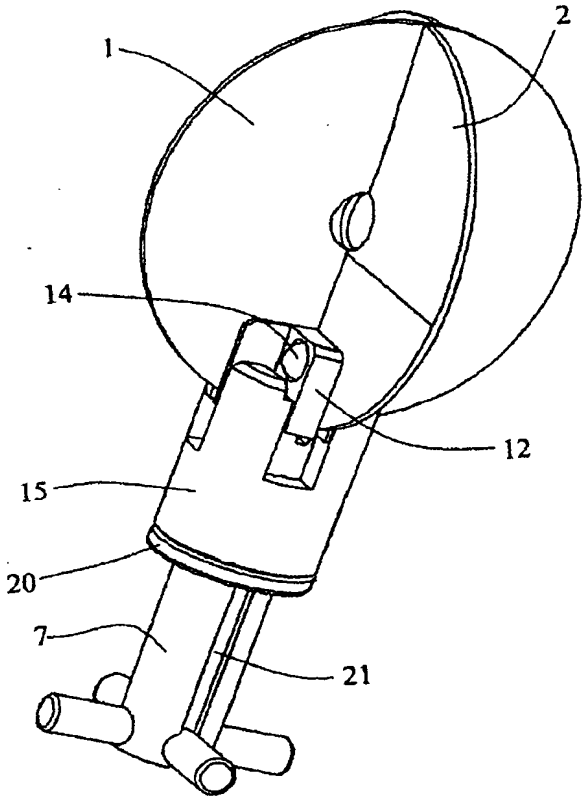
(54) Title: SURGICAL REAMER



(57) Abstract: A low insertion profile surgical reamer for cutting a bone socket comprises a cutting structure. The cutting structure is rotatable about a longitudinal axis. The structure has a static profile area upon insertion of the reamer into the bone socket and a dynamic profile area generated upon rotation, both profile areas lying transverse to the axis. The static profile area lying transverse to the axid. The static profile area is substantially smaller than the dynamic profile area. The reamer includes centrally located holes (18), allowing it to be fixed to a tool holder.

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SURGICAL REAMER

Background of the Invention

The subject of this invention is a surgical reamer fitted with a device allowing it to be fixed to a tool holder so that it can be driven in rotation and with at least one cutting edge made up of the edge of a plate containing the reamer's rotary axis.

A reamer of this sort is known under US patents 3,633, 583 and 5,290,315. On these reamers, the cutting edge is formed on a half-disk inserted into a diametric split made in a monolithic head which is noticeably hemispherical. The disk is held in the head by a screw and the head has gashes, like a drill bit, for the formation of shavings. In operation, there is an increased risk of these reamers becoming off centre due to the lack of homogeneity of the osseous matter.

From document EP 0 947 170, the content of which is incorporated herein by reference, a surgical reamer is shown, particularly intended for the processing of the cotyloid cavity when replacing the hip joint with a total prosthesis, in the shape of a revolving hollow body, in particular a hemispherical cap stretching from one side of the rotary axis and whose edge, over half of its circumference, constitutes the cutting edge. The surface of the cap itself may be fitted with teeth as with reamers of the rasp type which are commonly seen in previous practice, as described, for instance, in patents FR 2 281 025, EP 0 704 121 and 0 782 890, the content of which is incorporated herein by reference. However, it is very difficult to form an exact hemisphere using the usual processes, such as stamping.

What is needed is a surgical reamer allowing the centring to be maintained whilst in operation, using simple means. In addition, what is needed is a reamer that has a small insertion profile, compared to its swept cutting area.

Summary of the Invention

A surgical reamer according to the invention has a cutting structure rotatable about a longitudinal axis. The structure has a static profile area upon insertion of the reamer into the bone socket and a dynamic profile area generated upon rotation, both profile areas lying transverse to the axis. The static profile area is substantially smaller than the dynamic profile area. The reamer includes centrally located holes (18), allowing it to be fixed to a tool holder. The invention therefore has a low insertion profile permitting entry into an incision of a relatively small size.

The reamer form may be spherical, conical or of some other shape. At least one cutting edge can be fitted with teeth.

According to the preferred mode of production for the invention, the reamer is made up of two plates which are split down the middle according to their axis of symmetry and housed at right angles to and inside one another. This is particularly simple to manufacture and also stands out due to its good rigidity and by how easy it is to clean.

The plates constitute the cutting structure. The plates are angularly arranged around the rotary axis in such a way as to form three edges including at least

one which is a cutting edge. The distribution of at least three edges around the rotary axis ensures that centring is maintained during milling. If only one of the edges is a cutting edge, the other edges are used only for guiding, that is to say for maintaining the centring.

The disk, whose split leads out onto the top of the reamer, can usefully be cut so as to release the profile of the other disk at the top and thus allow a cut in the centre when milling.

The plates have holes used for fixing the reamer onto a tool holder or an adapter with a head fitted with frontal slots extending radially in relation to the support axis and oriented in such a way as to allow them to house the reamer plates. The devices used to hold the reamer in the slots are usefully made up of balls which engage in the holes on the reamer's plates and a ball locking device keeping the balls engaged in the holes in the plates.

Brief Description of the Drawings

As an example, the appended drawing shows a mode for producing the invention.

Figure 1 is a perspective view of the reamer.

Figure 2 shows three examples of teeth formed on the disks.

Figure shows examples of disk cutting profiles.

Figure 4 shows the same reamer mounted on an adapter.

Figure 5 shows the adapter in the reamer release position.

Figure 6 is a side view of the adapter.

Figure 7 is an axial view of the adapter.

Figure 8 is an exploded view of the adapter.

Figure 9 shows a cup for recovering the shavings before being mounted on the reamer.

Figure 10 shows the same cup mounted on the reamer.

Figure 11 shows a variant for point or centring stock production.

Figure 12 shows an embodiment in which the plates are not equally spaced about the rotational axis.

Figure 13 shows the static profile area vs. the dynamic profile area of the invention.

Figure 14 shows the static profile area vs. the dynamic profile area of a prior art product.

Detailed Description of the Invention

The reamer shown in figure 1 is made up of two disks or plates 1 and 2 perpendicularly assembled. The plates 1 and 2 make up a cutting structure 50. The cutting structure 50 is rotatable about a longitudinal axis X-X when mounted to a holder 6.

For this purpose, the plates are split down the middle, that is to say according to a radius leading into a central circular cut 3 and they are housed in one another by means of these slots and laser welded so as to give a spherical case of which edges 4 and 5 make up meridians. Edges 4 and 5 present sharp edges forming cutting edges.

In the example shown, disk 1 has a split which leads to the top 30 of the reamer and is cut so that the sides of its split 31 diverge from one another on the plane of the other disk 2, on both sides of the

reamer's rotary axis X-X. The effect of this is to release the edges of the disk 2 at the top 30 and to thus allow a centre cut when milling.

At least one of the edges 4, 5 of the plates can be fitted with cutting teeth. Examples of teeth shapes are shown in figure 2, either teeth in a U shape (a), an "N" shape (b) or sloping slot teeth (c). The four edges of the reamer should preferably be fitted with teeth and these teeth are offset, respectively alternated, from one disk to the other or from one half-disk to the next, in relation to the trajectory of these teeth, so as to obtain a full sweep, without grooves, when milling a spherical cavity.

The cutting edges 4 and 5 may show various cutting profiles examples of which are shown in figure 3

a) half-moon profile on the topside,

b) elliptical profile generating a positive cut,

c) half-moon profile on the cutting side of the plates with a neutral cutting angle

d) half-moon profile on the cutting side of the plates with a positive cutting angle

e) diagonal profile generating a positive cutting angle,

f) neutral profile,

g) half-moon profile on the topside with two relief angles per disk,

h) half-moon profile on both sides of the plates,

i) tenon profile which can synthesise profiles a) to h).

A reamer of this sort cannot be fixed directly onto a tool holder as described in the applicant's patent EP 0 704 191 (US 5,658,290), the content of which is incorporated by reference herein, which has a head intended to house a cross held by a bayonet fixture. In order to be able to use the same tool holder for reamers fitted with a fixing cross, the new reamer is fixed onto an adapter 6 shown in figures 4 to 8. This adapter could obviously constitute a full tool holder.

The adapter 6 has a cylindrical body 7 fitted, at one end, with a head 6 designed to house the reamer and, at the other end, with a fixing cross made up of four cylindrical branches 9 forced radially through the body 7. The head 8, generally cylindrical in shape, is split diametrically so as to have four slots 10 which are at right angles to one another, whose width corresponds to the thickness of plates 1 and 2. These slots 10 are limited on one side by a relatively thin wall 11 and, on the other side, by a rather thicker wall 12. The walls 12 are pierced by a circular hole 13, which is cylindrical over most of the walls. The balls 14, whose diameter is greater than the thickness of the walls 12 are held in these holes. These balls 14 can also be moved into the holes 13 so as to release the slots 10 or not.

A locking ring 15, with four pins 16 is mounted, sliding, onto the body 7 stretching out in parallel to the axis of the ring. These pins 16 are engaged in the head 8, more precisely in the spaces left free by the walls 11 and 12. Each of these pins 16 has one flat

side 17 which at least approximately slides onto the side of a wall 12 opposite the corresponding split 10, so as to keep the corresponding ball engaged in the split 10, as shown in figure 7. If the reamer is engaged in the slots 10, the balls 14 are then engaged in the holes 18 on plates 1 and 2 so that the reamer is held onto the head 8.

The ring 15 is held in this locking position by a spring 19 which rests on a supporting ring 20 which is mounted on the body 7 of the adapter, as shown in figure 4. In order to release the reamer all that must be done is pull out the locking ring 15 by constricting the spring 19, as shown in figure 5. The reamer can then be removed from the head 8 by pushing back the balls 14. The same method is used to fix the reamer onto the adapter. This type of locking/unlocking mode is described in the Swiss patent application No 409/00, the content of which is incorporated by reference herein. To lock the balls 14 into the reamer, all you have to do is release the ring 15.

In order to allow the adapter to be cleaned properly, the supporting ring 20 is mounted in such a way that it can be pulled out backwards as far as the fixing cross 9, which allows you to also bring back the locking ring 15 and to release the spring on the ring 15. For this purpose, the supporting ring 20 is fitted with a radial pin directed internally (not shown in the drawing) and the body 7 of the adapter has a longitudinal groove 21 into which this pin can slide. The upper end of the groove 21 leads to a notch 22 into

which the pin on the ring 20 can be bayonet fixed by means of a slight rotation.

The reamer can usefully be fitted with a device allowing the shavings to be recovered. The plates offer a particularly simple and effective solution shown in figures 9 and 10.

The recovery devices are made up of a cup 32 in the shape of a hemispherical dome supported by a flange 33. The diameter of the dome 32 is slightly less than the diameter of the plates 1 and 2 and this dome has four splits 34 stretching according to the meridian levels at right angles to one another and over a part of the height of the ring 33, over a part 35 of the latter which has the same diameter as the dome 32. The width of the splits 34 is noticeably greater than the thickness of the plates 1 and 2 and these splits are asymmetrical in relation to the corresponding meridian plane, in such a way that when the cup 32 is mounted on the reamer (figure 10) the plates 1 and 2 cross the splits 34 leaving a split 34' behind the plates in relation to the reamer's direction of rotation, so as to allow the shavings to penetrate into the cup 32 through these splits 34'. It will be noted that the reamer plates shown in figures 9 and 10 are fitted with U-shaped teeth which project over the surface of the cup 32.

Figure 11 illustrates a variation in which the two plates 1 and 2 are totally flat and form a cross at the end of the reamer. The reamer is fitted with a drill bit 36 fixed axially onto this cross. For this purpose, the bit 36 has two slots running crossways by means of

which it is fitted onto the plates. The bit is laser welded onto the plates 1 and 2.

Instead of a bit, a simple centre point or a trocar point 37 could be fitted.

A drill bit or a point could be fixed in the same way onto a reamer made up of three, five or more plates.

Figure 13 illustrates a cutting structure 50, made up of the two plates 1 and 2. When viewed statically and axially, the cutting structure 50 presents a two dimensional static profile area 52 in the form of a cross. The square 53 inscribed on the corners of this cross represents the minimum size of an incision which will allow passage of the reamer. The square 53 is therefore the effective profile seen by an incision upon insertion of the reamer into the bone socket and covers approximately 80% of the area of the circular profile area 54. When this static profile 52 is rotated during cutting, it sweeps out the circular profile area 54 inscribed by the phantom line circle 56.

Figure 14 shows a conventional reamer 60, in which the static profile area 62 is essentially a circle with small protrusions 64 constituted of cutting divots. When rotated during cutting, the static profile area 62 sweeps out a dynamic profile area 66, inscribed by the phantom line 70, only insubstantially larger.

Thus, an advantage of having a substantially smaller static profile area 52 than dynamic profile area 54 is that the size of the incision required in

order to receive the reamer is much smaller than that required for conventional reamers.

The invention is not limited to the modes of production described. Instead of the two fitted plates, the reamer could be made up of plates fixed radially on an axis, by means of welding, for instance. There do not have to be exactly four plates, but there must be at least one.

Whether these are plates fitted as shown or plates welded onto an axis, these plates could be of a different shape, for example a shape limited by a truncated or other form of case.

What is claimed is:

1. A surgical reamer for cutting a bone socket, comprising,

   a cutting structure rotatable about a longitudinal axis, having a static profile area upon insertion of the reamer into the bone socket and a dynamic profile area generated upon rotation, both profile areas lying transverse to the axis,

   wherein the static profile area is substantially smaller than the dynamic profile area .

2. The surgical reamer of claim 1 wherein the reamer is adapted to be mounted to a tool holder for controlled rotational motion.

3. The surgical reamer of claim 1 wherein the dynamic profile area has a circular area.

4. The reamer of claim 1 wherein the cutting structure further comprises at least one plate with an edge adapted to cut bone.

5. The reamer of claim 1 wherein the cutting structure further comprises a pair of plates mounted so as to traverse the rotational axis.

6. The reamer of claim 5 wherein the static profile area has a cruciform shape.

7. The reamer of claim 1 wherein the static profile area is no greater than about 80 percent of the circular area.

8. An acetabular reamer comprising,

a support structure rotatable about a longitudinal axis, presenting a plurality of cutting edges, the support structure further defining a static profile area upon insertion into the bone and a dynamic profile area which is circular, the dynamic profile area being generated upon rotation, both profile areas being transverse to the axis,

wherein the reamer has a static profile area which is substantially smaller than the dynamic profile area.

9. The surgical reamer of claim 8 wherein the reamer is adapted to be mounted to a tool holder for controlled rotational motion.

10. The reamer of claim 8 further comprising at least one plate with an edge adapted to cut bone.

11. The reamer of claim 8 further comprising a pair of plates mounted so as to traverse the rotational axis.

12. The reamer of claim 11 wherein the static profile area has a cruciform shape.

13. The reamer of claim 8 wherein the static profile area is no greater than about 80 percent of the dynamic profile area.

14. A surgical reamer for cutting a bone socket, comprising two intersecting plates (1, 2), rotatable about a longitudinal axis (X-X) when mounted to a holder (6), the plates sweeping a circular cutting profile area (54) when rotated axially with the holder, wherein the plates present a two dimensional static profile area (52) in the form of a cross substantially smaller than the circular cutting profile area (54), wherein the plates have a holder interface (18) centrally located with the longitudinal axis, permitting a holder to have a small outside dimension so that when the holder and reamer are attached to each other in an assembled arrangement, the holder may sweep out a diametral area substantially smaller than the circular cutting profile area (54), thus permitting a substantially smaller incision for entry of the reamer into a body.

15. The reamer as in claim 1, wherein at least one cutting edge is fitted with teeth (fig. 7a, b, c).

16. The reamer as in claim 15, wherein all of the cutting edges are fitted with teeth, the teeth of one edge being offset in relation to the teeth of another edge according to the trajectory of the teeth.

17. The reamer of claim 1 having at least two plates (1, 2) split down the middle along their axis of symmetry, fitted at right angles and fixed to one another.

18. The reamer of claim 1, wherein the plates (1,2) are in the shape of disks.

19. The reamer of claim 1, fitted with a bit (36) or a centre point or a trocar point (37) attached to the plates (1, 2) coaxial with the rotary axis of the reamer.

20. The reamer as in claim 17, wherein the split of the disk (1) extends to the top of the reamer and is cut so that its sides diverge from one another on the plane of the other disk, on both sides of the reamer's rotary axis.

21. The reamer of claim 14, wherein the holder interface comprises a hole (18) in the plate allowing the reamer to be fixed onto a tool holder or an adapter (6).

22. The reamer of claim 1, including a device for recovering the shavings (32).

23. The reamer of claim 22, wherein device for recovering the shavings is made up of a cup (32) located at the centre of the reamer.

24. The reamer of claim 23, wherein the cup (32) is in the shape of a dome fitted with diametric slots (34) traversed by the plates (1, 2).

25. The reamer of claim 14, wherein the plate (1,2) has a circular cut (3) in which the cup for the recovery of the shavings is housed.

26. A surgical reamer for shaping a bone socket in a patient, comprising:
A cutting structure rotatable about a longitudinal axis, defining a shape with a static profile transverse to the axis upon insertion of the reamer into the patient, and another shape with a dynamic profile generated upon rotation of the structure within the socket, wherein the static profile is substantially smaller than the dynamic profile.

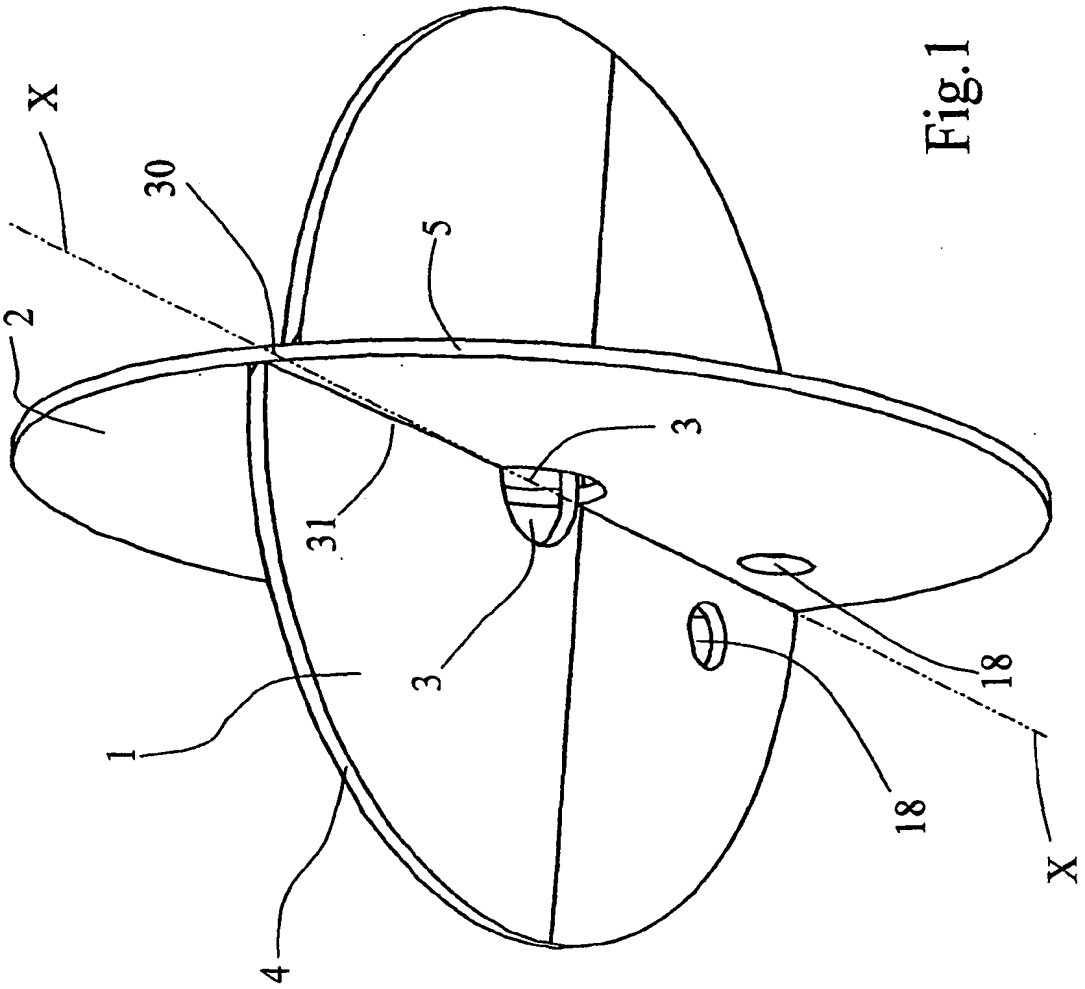
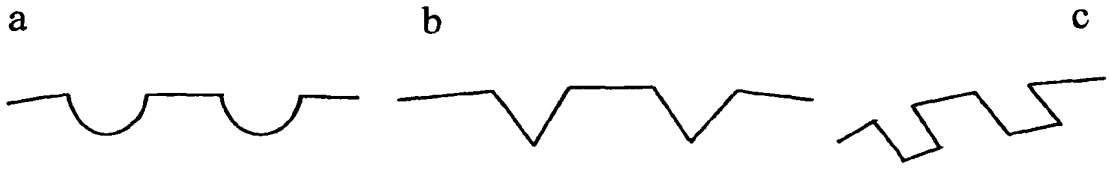


Fig.1

Fig.2



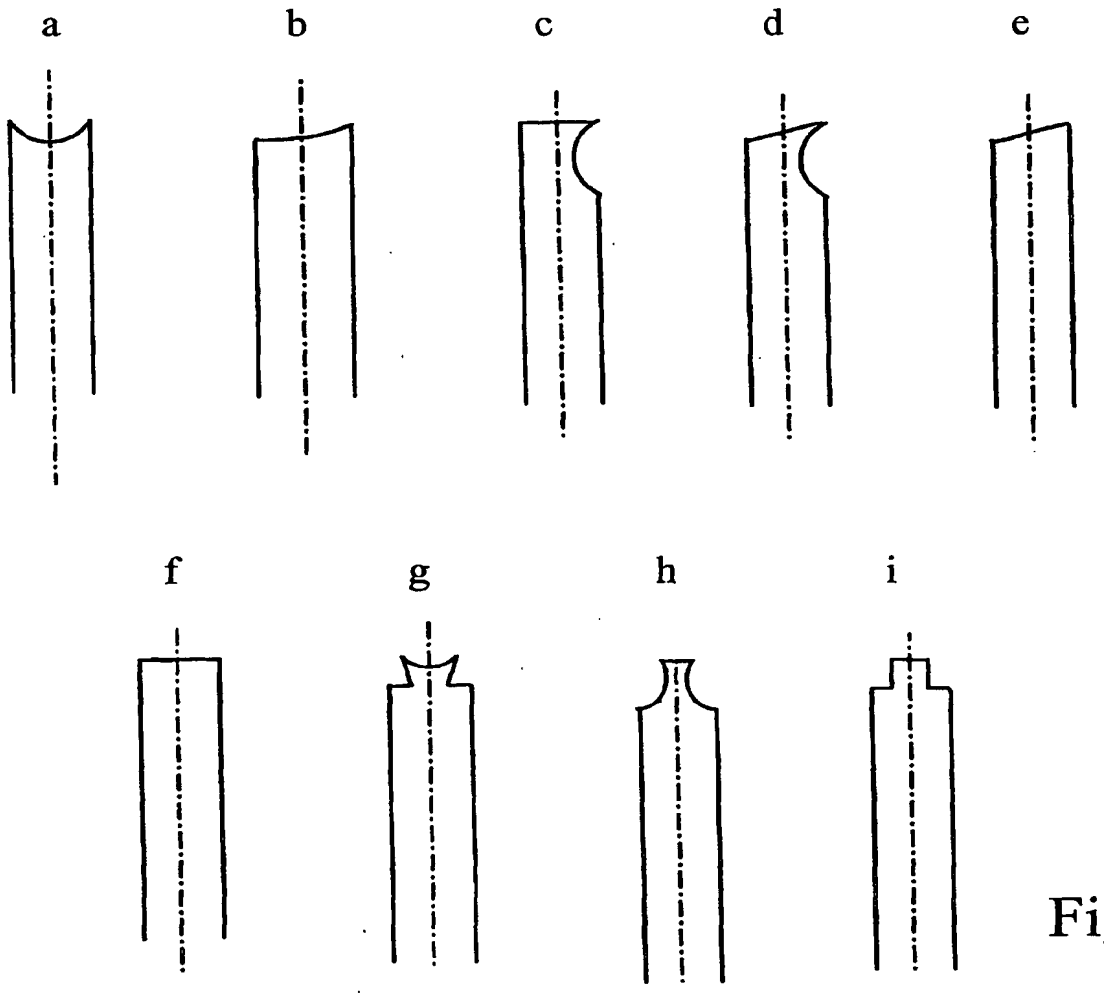


Fig.3

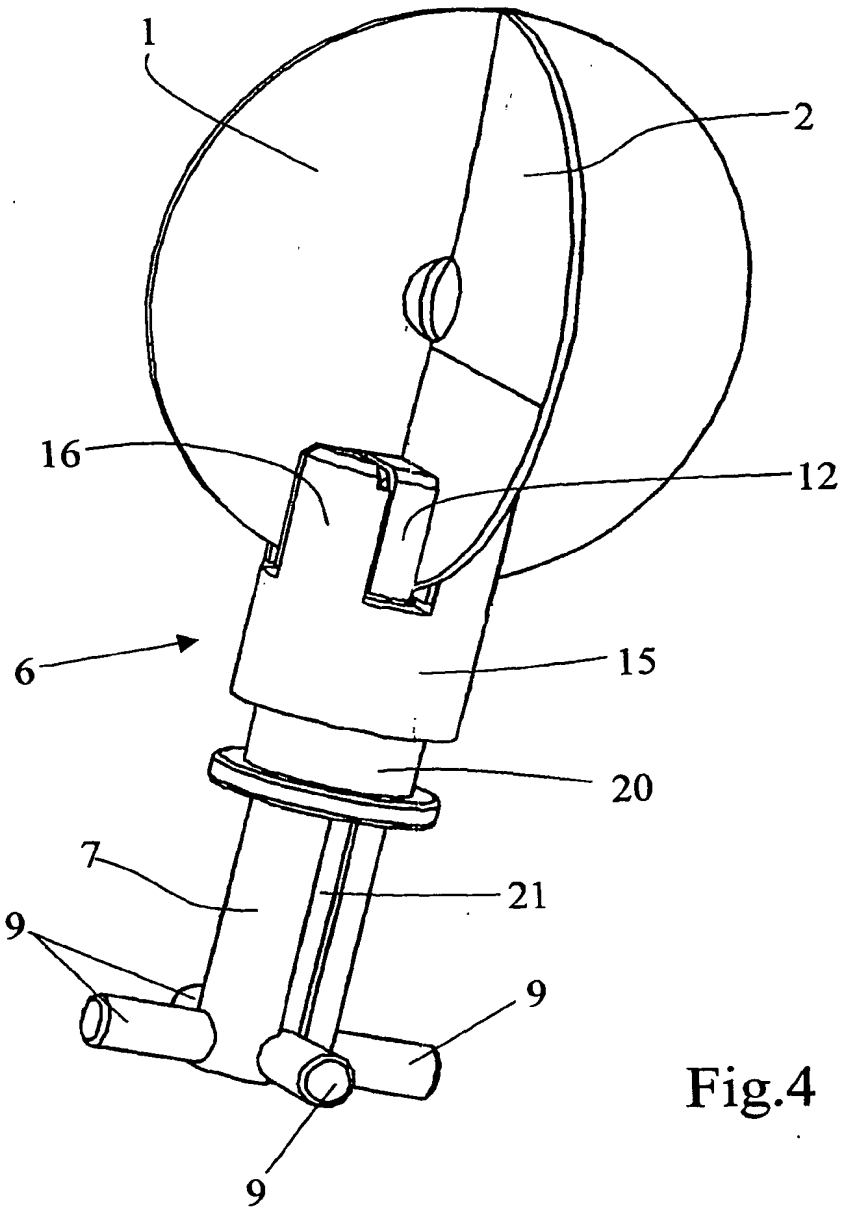


Fig.4

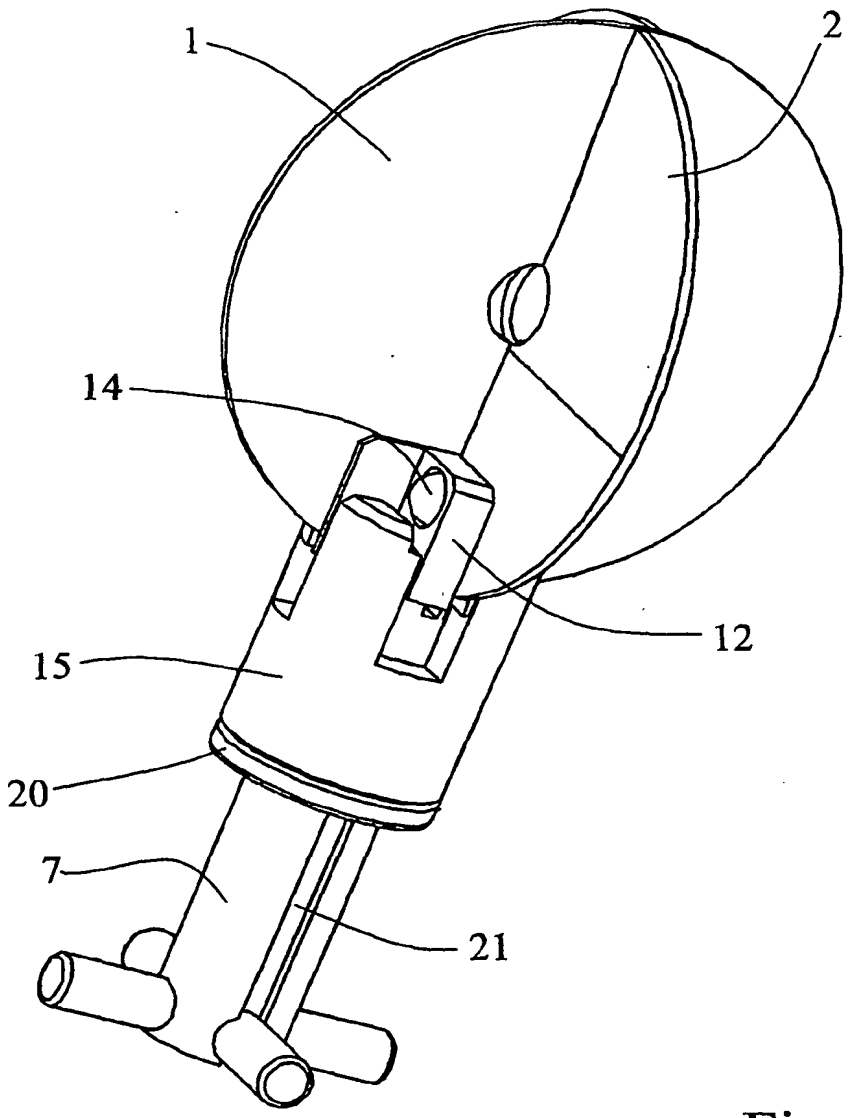


Fig.5

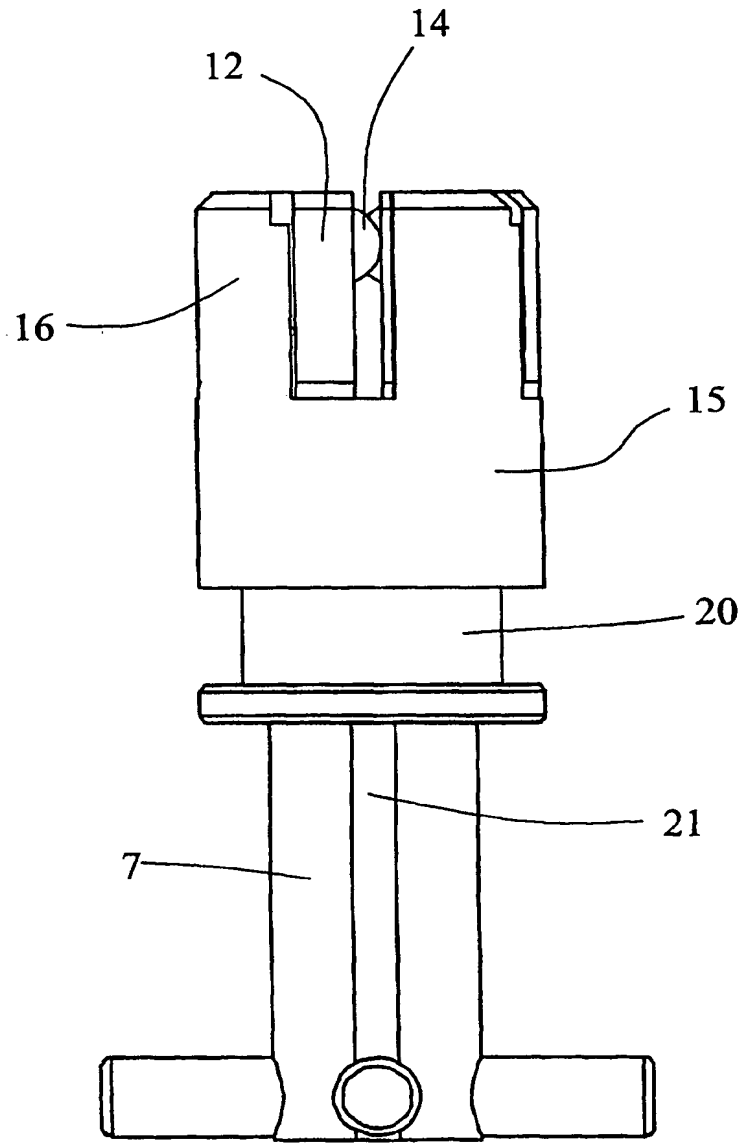


Fig.6

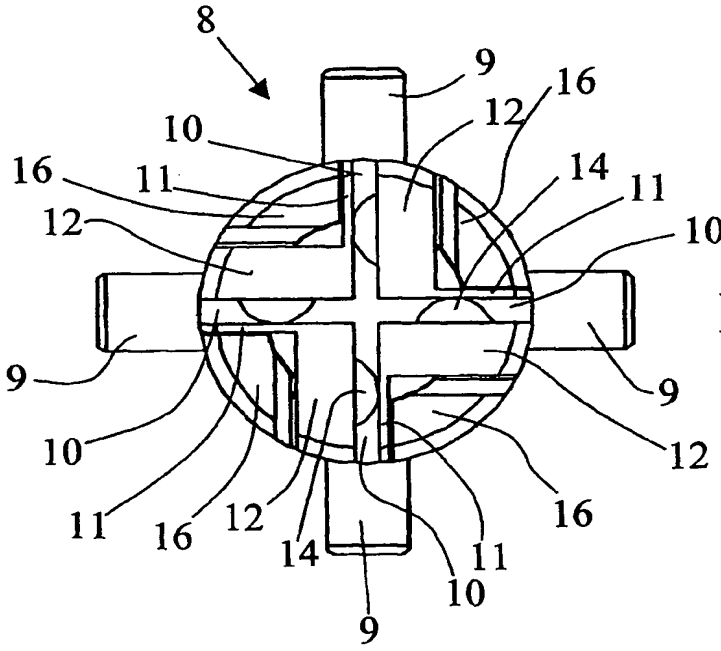


Fig.7

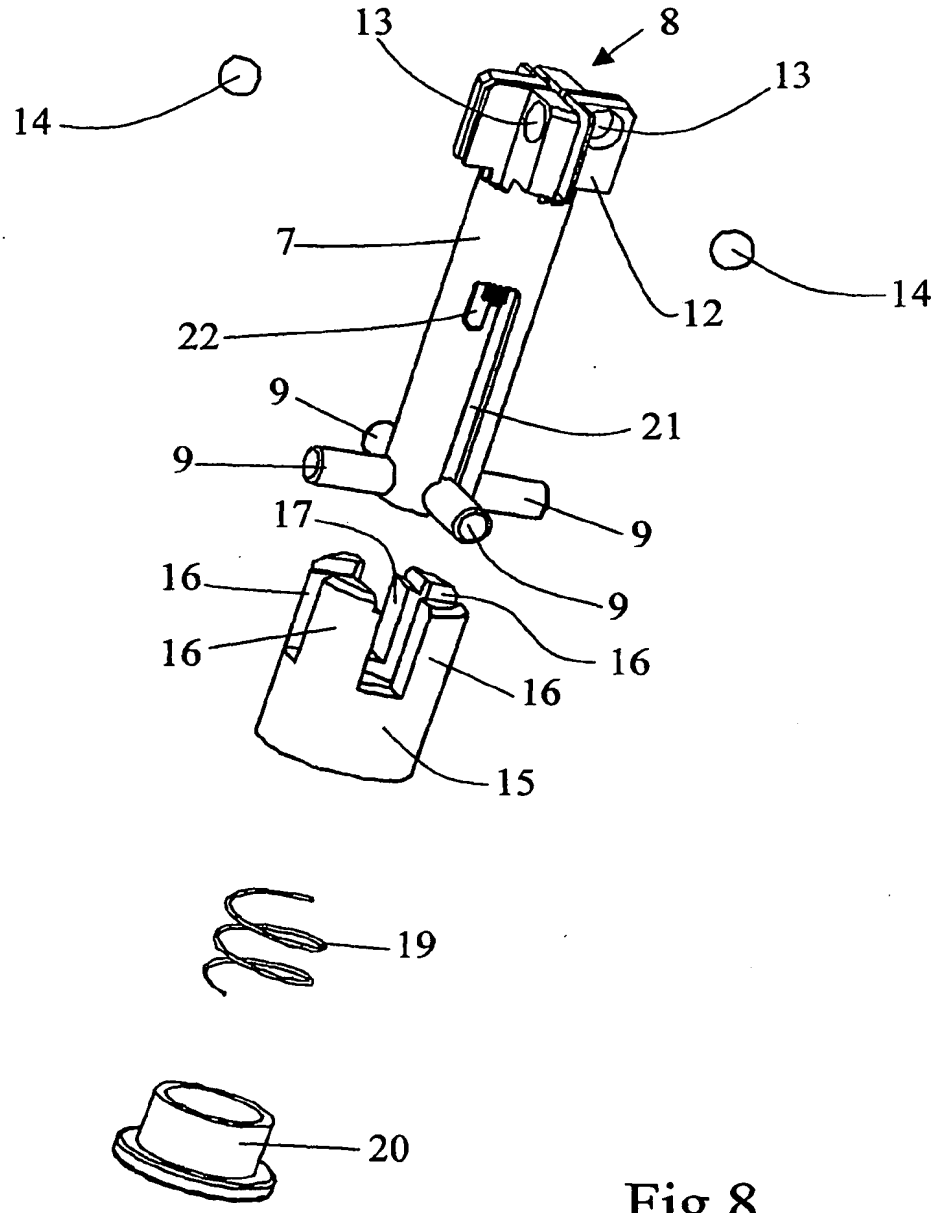


Fig.8

Fig.9

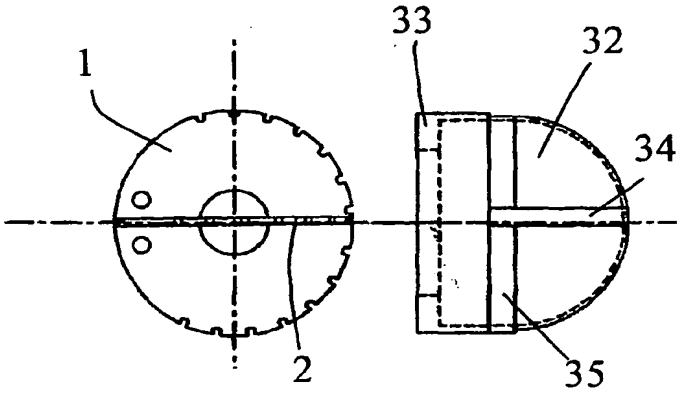


Fig.10

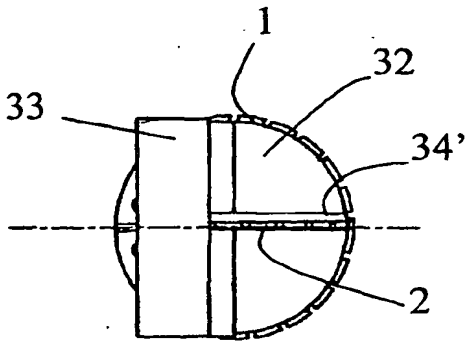
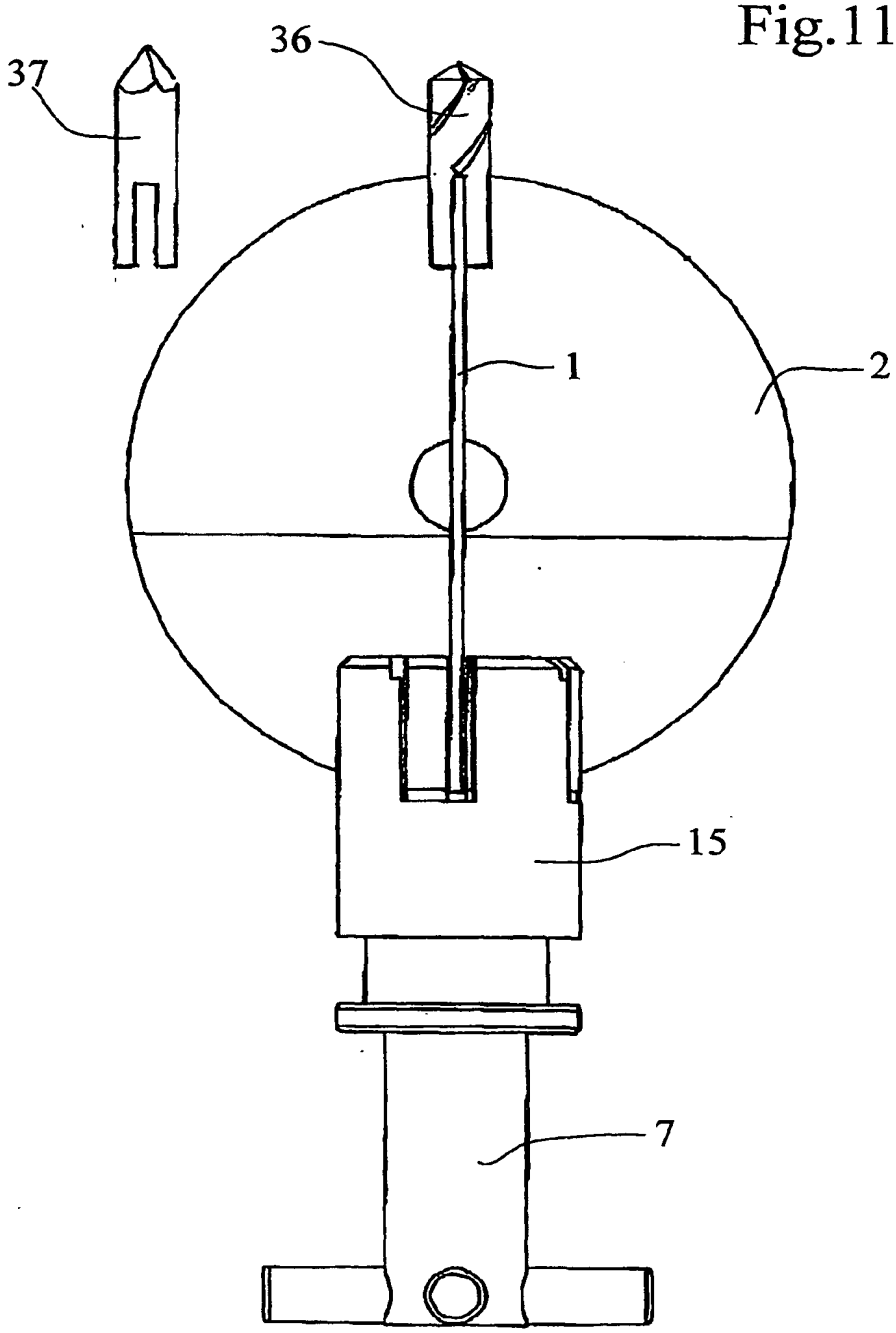


Fig.11



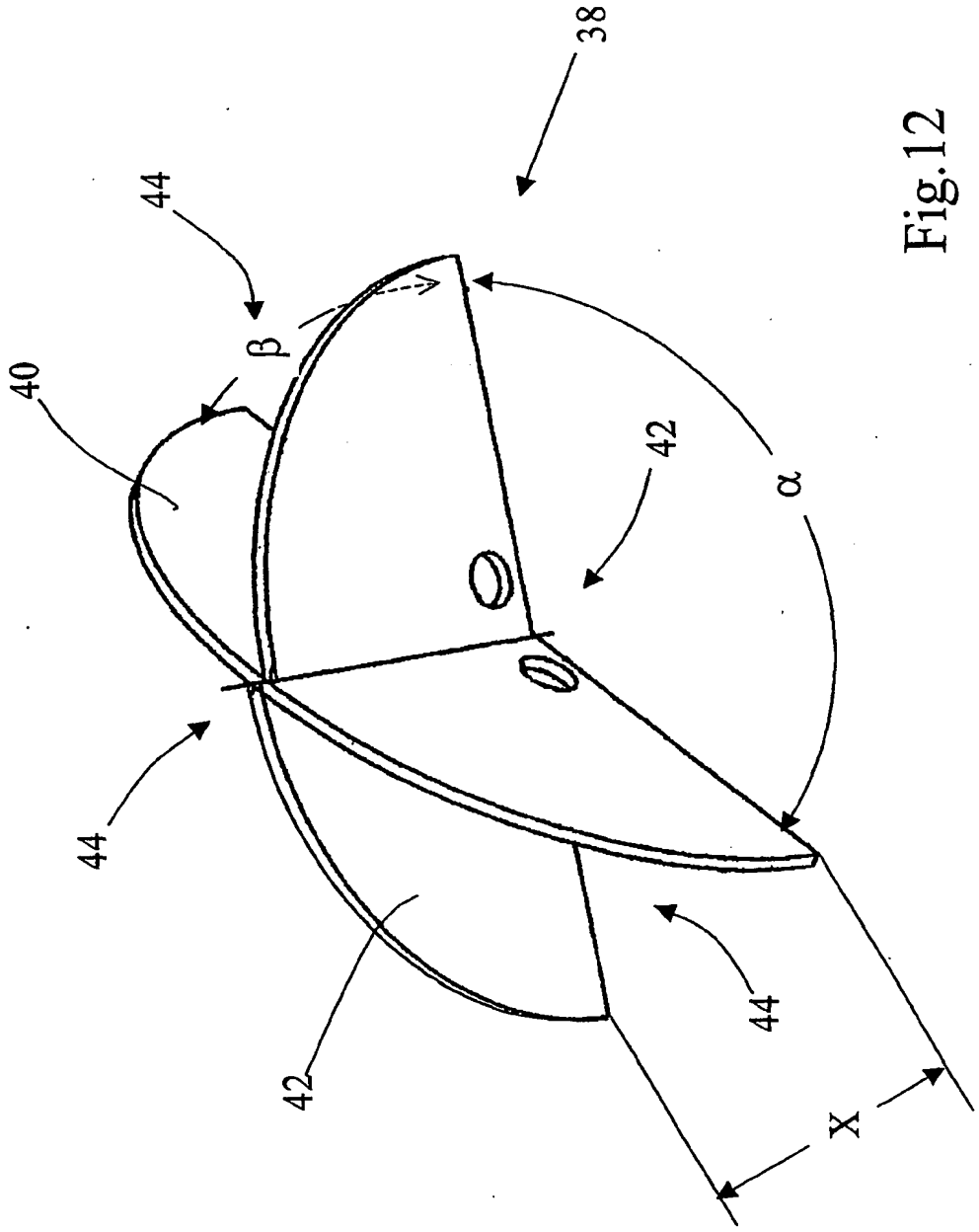


Fig.12

Fig.13

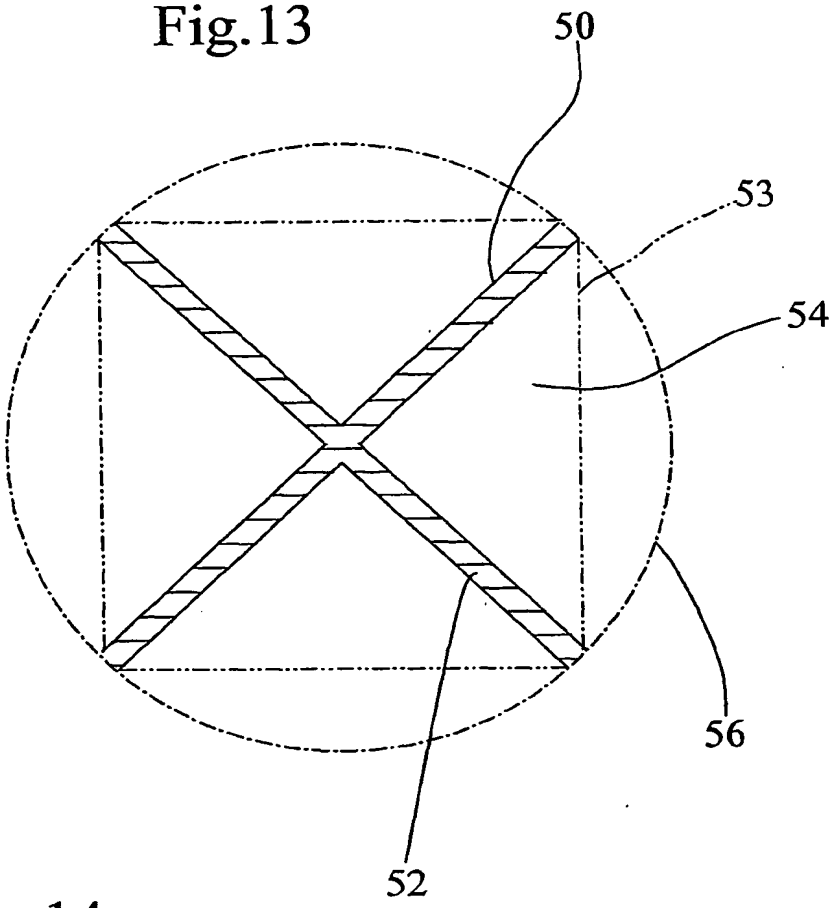
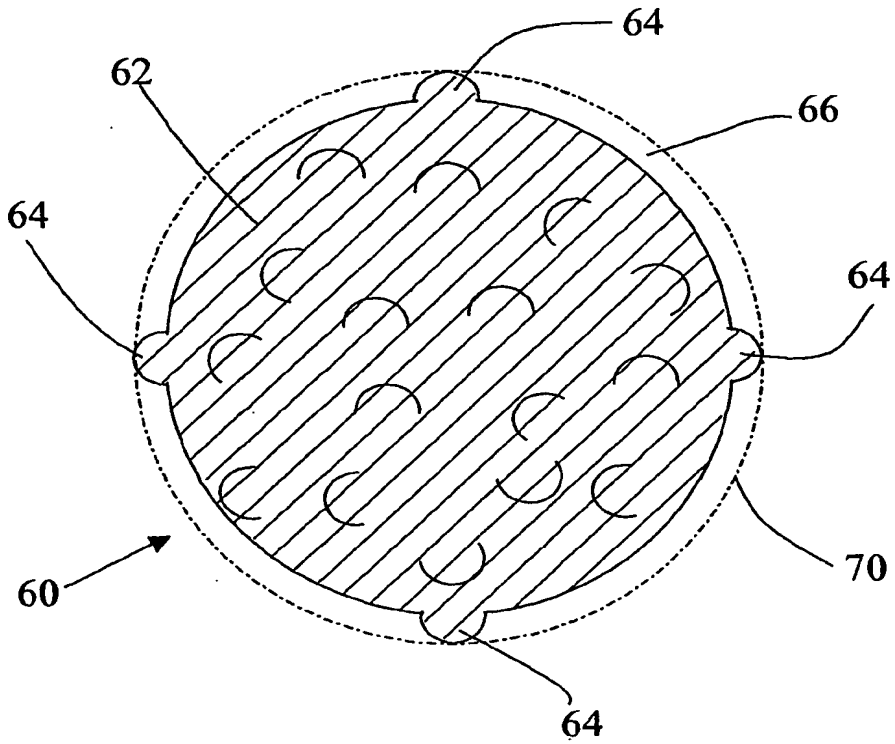


Fig.14



INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 01/02676

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B17/16 A61F2/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 15 66 114 A (WALDEMAR LINK) 22 October 1970 (1970-10-22) page 1, paragraph 2 -page 2, paragraph 1; claim 1; figure 3	1-15,26 17,20
X A	EP 0 947 170 A (PRECIFAR SA) 6 October 1999 (1999-10-06) abstract; claims 1,3; figures 1-4	1-3,7, 15,22, 23,26 8,13
A Y	US 5 897 558 A (ABRAHAM THOMAS ET AL) 27 April 1999 (1999-04-27) abstract; figures 1,2 column 1, line 66 -column 2, line 3 column 2, line 14-18	4-6, 10-12,15 17,20

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	FR 1 031 888 A (VINCENT GASTON) 26 June 1953 (1953-06-26) claim 1; figure 3	4-6, 10-12,17
A	FR 2 233 972 A (C E R A V E R) 17 January 1975 (1975-01-17) page 2, line 2,3,10-13; figures 4-6,10-12,17,19 page 3, line 11-23	4-6, 10-12, 17,19
A	US 5 299 893 A (SALYER PAUL E ET AL) 5 April 1994 (1994-04-05) column 2, line 6-8 column 7, line 37-49	22-25

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB 01/02676

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 1566114 A	22-10-1970	DE 1566114 A1	22-10-1970
EP 0947170 A	06-10-1999	CN 1230391 A	06-10-1999
		EP 0947170 A2	06-10-1999
		US 6106536 A	22-08-2000
US 5897558 A	27-04-1999	US 5755719 A	26-05-1998
		AU 5707698 A	07-08-1998
		WO 9831291 A1	23-07-1998
FR 1031888 A	26-06-1953	NONE	
FR 2233972 A	17-01-1975	FR 2233972 A1	17-01-1975
US 5299893 A	05-04-1994	US 5100267 A	31-03-1992